Estimation of Incidental Takes of Seabirds in the Hawaii Longline Fishery, 2002

This note provides a brief summary of the statistical methods used to estimate the incidental takes of seabirds in the Hawaii longline fishery for the year 2002. Take estimates for each quarter of the year are presented in the table below. For the purpose of this report, an incidental take refers to an animal that is hooked or entangled. A trip's incidental take is assigned to the quarter that the vessel arrived back into port after completing the trip. Thus the reported estimates refer to the total take on all longline trips completed during the particular quarter, regardless of when the takes actually occurred.

Despite higher observer coverage in 2002 than in previous years, the paucity of interactions with sea birds, as well as other protected species, required a different statistical approach to estimating take than the modeling approach used in previous years. To estimate the takes for year 2002 estimators based on sampling probabilities, the probability a trip was included in the sample, were used. To improve the accuracy of the sample-based estimator the sampling protocol for selecting trips changed during the second quarter of 2002. Because this change took place mid-quarter, take estimates for the first two quarters were estimated differently than for the last two quarters. Although trips were typically selected by a random scheme during the first two quarters the sampling probabilities were unknown. When modeling the probability that a trip had an observer onboard, a reasonable model suggested that the sampling probabilities were fairly constant during the first quarter. Therefore, a simple random sample without replacement was assumed when estimating the first quarter's takes. The second quarter was split into two temporal strata, as it appeared that coverage was fairly constant within each time stratum but different between strata. Therefore, when estimating the second quarter's takes a stratified sample was assumed, with simple random sampling without replacement within each stratum. Although the estimators used are unbiased under the stated assumptions, we have approximated the sampling probabilities and are not under the pretense that our estimators are unbiased.

During the second and third quarters, trips were selected using a systematic design with additional trips being selected when needed. These additional trips were selected with equal probability from a pool of vessels that had recently called in to NMFS, as required, to report their intended departure. Coverage is not always constant throughout the quarter as the number of observers available and the level of fishing activity can fluctuate. Observers are not paid when on land waiting to be assigned to a trip, and it is desirable to keep them fully employed if vessels are available. Therefore, additional vessel trips may be drawn from the available pool to accommodate an observer. This "systematic-plus" design permits the coverage level to be adjusted as needed. However, the additional sampling does depart from a probability sample since the day when additional samples are drawn is not randomly selected but determined by the need to draw additional samples on that day. The sampling probabilities during the periods when additional samples were drawn were computed by enumerating the number of trips calling in during the period of higher coverage and assuming that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. During the third and fourth quarters there were also short periods when coverage was below that of the anticipated systematic sample and several systematic samples were missed. In this situation, the sampling probabilities were computed by enumerating all trips that called in during this period and assuming that the trips sampled were selected with equal probability. Because of the additional sampling and periods of lower coverage, the trips in the third and fourth quarter were not selected with equal probability. Therefore, the Horvitz-Thompson estimator was used to estimate total take. A more detailed explanation of the systematic-plus sampling protocol and the formulas for computing the sampling probabilities required by the Horvitz-Thompson estimator will be forthcoming in a technical report. Confidence intervals have not been provided as an appropriate method for approximating them has not been verified.

When there were no observed takes during a quarter, the Horvitz-Thompson estimate of total take and the estimated standard error of this take estimate was zero. Although the estimate of the standard error was zero, there is uncertainty in the estimate of total take. Thus, standard errors for quarters where there were no observed takes for a species are not reported in Table 1. To provide an indication of the level of uncertainty, it was assumed that the takes per trip for the species of concern were independent Poisson variates with a constant mean value (Poisson parameter). This constant mean was defined as the parameter value consistent with a specified chance of observing zero takes in the observed longline sets. The parameter value was estimated corresponding to a 50% chance of observing no takes in the observed sets. This value was then used to estimate the standard error of the sample-base take estimate for that quarter. This estimate is likely biased.

Year 2001 and 2002 estimates of the incidental take of seabirds in the Hawaii longline fishery

	2001 Quarterly Estimates		2002 Quarterly Estimates			
Species	1	Quarter 2,3,4	1	2	3	4
Black-footed Albatross	215 (s.e. 26.08)	43 (s.e. 18.34)	51 (s.e. 13.8)	3 (s.e. 2.8)	0 (s.e. 5.0)	11 (s.e.10.8)
Laysan Albatross	145 (s.e. 21.30)	107 (s.e. 90.68)	48 (s.e. 16.0)	3 (s.e.2.8)	0 (s.e. 5.0)	0 (s.e. 4.5)